Spec.

BAG FILLING APPARATUS AND METHOD

Field of the Invention

This invention relates to packaging technology, and in particular to an apparatus and method for filing bags with a loose commodity such as seed or grain, by means of an automated apparatus, and carrying the filled bags to a bag sealing station or other processing means.

Background of the Invention

The bagging of bulk commodities such as seed or grain requires automated equipment for sequentially dispensing a measured quantity or weight of a commodity into an open-topped bag, and transferring the bag to a heat sealing station or other bag-sealing means. Typically in apparatus of this nature, the bulk commodity is dispensed from a hopper into an open-topped bag. After a measured amount is dispensed, the bag is removed from the hopper and discharged from the apparatus. Typically, individual bags are positioned beneath the hopper sequentially. Modern commodity-handling operations require bag filling machines that are capable of operating rapidly and effectively, that is, with a minimum of skipped bags (wherein a bag is missing when the hopper discharges it s load), torn or damaged bags, or doubled-up bags.

Typically, rapidity and precision are achieved by means of an automated device having moveable fingers or other gripping members for manipulation of individual bags before, during and after the filling operation. For example, published Canadian Application 2,091,471 (Huwelmann) discloses a bag-filling apparatus having opposed clamping mechanisms for gripping the open upper end of the bag, and holding the bag open for filling by a hopper or the like. Similarly, U.S. 4,172,349 (Lipes) discloses opening of a bag by means of a pair of opposed gripping members that grip opposing sides of the bag and hold it open at its mouth. A similar arrangement is disclosed in U.S. 4, 651,506 (Lerner et al.).

One requirement is that such apparatus accurately and rapidly transfer individual bags from a bag supply to a filling station and subsequently to a conveyor for transferring the bag to a heat-sealing mechanism or other bag-handling subsystem. This sequence may be efficiently carried out if the bags are transferred efficiently between the various stations.

A further specific requirement that is not adequately addressed in the prior art is for a simple, effective and rapid means whereby empty bags are individually engaged and positioned in an open-topped position to receive a bulk commodity from a hopper or other filling means.

In general terms, it is desirable to provide a mechanism whereby empty bags may be sequentially engaged and transferred in an open position to a bag-filling station, and subsequently transferred to a bag conveyor. Conveniently, the individual bags may be drawn closed as they are being fed to the downstream conveyor. Since typically the downstream conveyor feeds the bags into a heat-sealing station comprising a pair of heated rollers or belts, it is desirable that the mechanism draws the sides of the bags together to form a flattened upper region of the bag to receive a heat seal.

Objects of the Invention

In light of the foregoing, it is an object of the present invention to provide an improved bag filling apparatus and method, whereby individual bags are selectively engaged and positioned for individual filling and subsequently are withdrawn from the filling station in a generally lateral direction for transfer to a downstream conveyor. It is a further object to provide a means whereby the filled bags are generally substantially closed at their upper ends as the bags are transferred to the downstream conveyor, in such a manner as to permit the bags to be conveniently heat sealed at their upper ends.

Summary of the Invention

In accordance with the foregoing objects, the invention comprises in one aspect an apparatus for filling bags with a loose commodity and transferring filled bags to a processing means, comprising:

a bag filling station for dispensing a measured quantity of the commodity into bags;

a wicket for receiving empty bags in a stacked and interconnected array whereby the bags form a continuous web; and

filled bag transfer means incorporating a releasable clamp for engaging an open mouth of a bag upon filling the bag with the commodity and withdrawing the filled bag away from the hopper.

The interconnection of the bags may be achieved by a mechanical interconnection, for example interlocking edge regions of adjacent bags, or surface effects such as surface tension or electrical attraction between contacting bags.

The releasable clamp draws the open mouth of the bag into a taut position upon engaging the bag. The direction of transfer of the filled bags permits removal of a filled bag from the filling station to draw a subsequent empty bag from said wicket to the filling station and detach the full bag from the subsequent bag. The transfer means then transfers the filled bags from the filling station to the processing means.

Preferably, the transfer means sequentially transfers the bag in a first direction generally perpendicular to the elongate axis of the apparatus for detaching a filled bag from a subsequent bag, and subsequently in a second direction generally parallel to the elongate axis for delivering filled bags to the processing means.

The clamp of the preferred version comprises a pair of laterally moveable fingers associated with drive means for moving the fingers between converged and diverged positions. The reciprocating fingers engage opposed corresponding fixed fingers, whereby opposed ends of the bag are clamped between respective pairs of moveable and fixed fingers when the moveable fingers are diverged, and the bag is released from the clamp member when the moveable fingers are converged. The position of the fixed fingers may be laterally adjusted to converge or diverge to accommodate a selected size of bag.

The filling station preferable includes a hopper having a downwardly-depending nozzle for discharge of the loose commodity, and further comprising reciprocating drive means for elevating the hopper during the bag removal stage and lowering the hopper during the bag filling stage.

An intermediary conveyor means may receive the filled bags from the transfer mean, to convey the bags by their upper rim to a heat sealing station or the like. The intermediary conveyor may comprise a pair of opposing elongated conveyor members, such as a pair of endless belts driven by pulleys, that diverge to receive a bag and converge to engage and transport the bag.

In a further aspect, the invention comprises a method for filling a bag with a loose commodity and transferring the filled bags to a processing means, comprising the steps of:

providing a bag-filling apparatus featuring a bag filling station, a wicket, and filled bag transfer means;

loading a supply of empty bags on the wicket in a stacked and interconnected array to form a continuous web;

opening the mouth of a first bag on the wicket;

filling the first empty bag with loose commodity at the filling station;

transferring the filled bag away from the filling station towards the processing means, thereby drawing a second connected bag into said filling

station, opening the mouth of the empty bag and detaching said first bag from said second bag; and transferring the filled bag to the processing means.

The step of transferring the filled bag away from the filling station may comprise transferring the filled bag in a first direction for detaching the filled bag from the subsequent bag, and subsequently in a second direction towards the processing means. Alternatively, transfers within the first and second directions may occur essentially simultaneously.

The step of transferring the filled bag may include the step of drawing the open mouth of the bag to a substantially closed configuration, by drawing apart opposed ends of the upper region of the bag, thereby drawing together the opposed sides of the bag, and delivering the substantially closed bag to the processing means.

Having thus described the invention in general terms, the invention will now be further characterized by reference to a description and illustrations of a preferred embodiment.

The directional references employed throughout this specification are in relation to the longitudinal axis of the machine comprising the direction the general direction of movement of the bags subsequent to the filling stage, i.e., from the filling station to the heat sealing station or other downstream processing means.

Brief Description of the Drawings

Figure 1 is a plan view, from above, showing the apparatus according to the present invention;

Figure 2 is a perspective view of the apparatus; illustrating the conveyer within the closed position;

Figure 3 is a further perspective view, illustrating the conveyer within an open position;

Figure 4 is a further perspective view of the apparatus;

Figure 5 is a further perspective view of the apparatus;

Figure 6 is a side elevational view of a portion of the apparatus;

Figures 7a through i comprise a series of perspective views, of a portion of the apparatus, illustrating operation of the apparatus;

Figure 8 is a perspective view of a portion of the device, illustrating a further embodiment of one aspect thereof;

Figure 9 is a further perspective view as in Figure 8;

Figure 10 is a side elevational view of the portion shown in Figure 8.

Detailed Description of the Preferred Embodiments

Referring to the figures, the apparatus globally denoted by reference 10 is supported on a frame 16. The apparatus comprises a bag-filling station 20, having associated therewith a bag wicket station 22 and a bag transfer station 26. The bag-filling station comprises a vertically reciprocating hopper 28, which is driven for a reciprocal vertical movement by a pneumatic drive cylinder 30. A supply conduit 32 feeds grain or other loose, bulk commodity (not shown) into the hopper 28. Release of commodity from the hopper 28 is controlled by means of an openable jaw structure 34 which defines the lower portion of the hopper and comprises a fixed jaw member 36 and a moveable jaw member 38 which pivots about a horizontal axis. The moveable jaw member 38 is driven for a reciprocal movement diverging and convergin with the fixed jaw member 36 by a pneumatic cylinder 40 mounted to the hopper 28. In the closed position, shown in Figure 2, the respective jaw structure 34 closed and commodity cannot escape from the hopper 28. Within the open position, shown in Figure 7(c), the jaw structure 34 is opened for the discharge of a measured amount of commodity from the hopper 28.

The bag wicket station 22 comprises a generally box-like support structure 43 mounted to the frame 16, and which slidably engages the hopper 28. The pneumatic cylinder 30 driving the hopper is mounted to an upper portion of the support structure 43. The wicket station 22 features a pair of wicket members 44, from which may be hung a flattened stack of empty bags 46 for filling with the commodity. The wicket members are angled downwardly to urge the bags towards the filling station via gravity. A pair of holes 48 extend through the upper rim portion of the bags 46 adjacent opposed sides thereof, to engage the wicket members 44. The bags 46 are interconnected to form an endless web or chain.

In a further aspect, an alternative arrangement of the wicket station is shown in Figures 8 through 10. Within this version, a wicket station 200 comprises paired wicket arms 202, which are angled downwardly towards the feeding station to feed the bags 46 via gravity towards the feeding station. The wicket arms 202 terminate at a plate like wicket knife assembly 206, mounted to the wicket station 22. A wicket knife 208 forms a gusset like web between the plate 206 and the wicket arms 202. The wicket knife has a knife edge 210 for slicing the bags as the same are drawn forwardly for removal from the wicket. Use of the wicket knife assembly, and consequent cutting of the bag, permits easier removal of the bags from the wicket with less stretching than a simple tearing action against the rounded wicket arms. Figure 9 illustrates with arrow 212 the direction of tearing of the bag as the same is pulled forwardly off the wicket, with the tear origin occurring at point 214 on the bag.

Conveniently, the interconnection may result from surface tension, static or electrical forces between the bags or mechanical forces achieved by deformation of a portion of the bags surrounding the holes, which permits each bag to lightly grip its neighbours. The interconnection between the bags is sufficient to permit each bag to draw it's neighbour forwardly and open the mouth of the neighbouring bag, as each bag is removed from the wicket upon filling.

The term "interconnection" encompasses a physical connection formed by eg. deformation of adjacent bags forming an interlocking structure, or surface effects such as surface tension forming a connection between adjacent bags.

The bag transfer station 26 comprises in general terms a bag gripper assembly 50; a gripper carriage assembly 52; and a bag conveyer station 54. The gripper assembly 50 is adapted to grip individual bags 46 and position each bag sequentially beneath the hopper 28 for filling with the commodity. Upon filling of the bag 46, the gripper assembly 50 and its associated carriage assembly 52 carry the bag to the conveyer station 54 which in turn receives the filled bag for conveyance to a heat sealing station 56 or other downstream processing means.

The gripper assembly 50 comprises a generally plate-like vertical base 60. A pair of fixed arms 62(a) and (b) extend laterally from either end of the base 60 towards the hopper 26. Each of the outer arms 62 terminates in a downwardly-extending finger 64. The fingers 64 are adjustable on the arms 62 to accommodate bags of differing sizes requiring a greater or lesser spread of the fingers 64 to hold the bags generally taut. Positioned between the fixed outer arms 62 and parallel thereto is a pair of moveable inner arms 66(a) and (b), having a similar configuration and each terminating in a downwardly depending finger 67. The inner arms 66 are each mounted to the base 60 for slideable movement relative to the base 60. The inner arms 66 are each connected to a corresponding pneumatic cylinder 70 mounted to the base 60, with the cylinders adapted to drive the inner arms 66 between reciprocating converging and diverging positions. The inner arms 66 are reciprocate between a converged first position, shown in Figure 7(a), wherein the fingers 67 of the inner arms 66 are spaced substantially apart from the fingers 64 of the fixed outer arms 62, and a second diverged position, shown in Figure 7(b), wherein the respective fingers 64 and 67 of the inner and outer arms meet to clampingly engage a bag 46 therebetween.

It will be understood that the linear reciprocating motion of the cylinders 70, as well as all other like drive means, may be replaced by any suitable drive means including rotary drive means such as a revolving wheel, with the driven member being pivotally mounted at a position adjacent the wheel perimeter for reciprocating sinusoidal movement.

The carriage assembly 52 is adapted to carry the gripper assembly 50 in three axis of movement, namely laterally, longitudinally and vertically. The carriage assembly 52 comprises a carriage frame 80, mounted to the apparatus frame 16. The carriage frame includes a pair of spaced apart parallel bars 82(a) and (b) which are fixedly mounted to the frame 16 along a longitudinal axis. A carriage 84 engages the bars 82, and includes a pair of sleeves 85 for slideable receiving the bars to permit the carriage 84 to slide longitudinally along the bars 82. A reciprocating pneumatic cylinder 88 mounted at one end to the carriage 84 and at the opposing end to the apparatus frame 16 drives the carriage 84 within a longitudinal direction. Extending upwardly from the carriage 84 is a rectangular pillar 88'. A corresponding rectangular sleeve 90 is slideably received on the pillar and is driven vertically relative to the support by means of a reciprocating pneumatic cylinder 92 mounted to the respective members. Mounted to a side of the sleeve 90 is a second, horizontally-oriented rectangular sleeve 94, the axis of which is in the lateral direction. The second sleeve 94 slidingly receives a beam 96, one end of which in turn is mounted to the base of the gripper assembly 50. Lateral reciprocating movement of the gripper assembly 50 relative to the carriage 52 is achieved by means of slidable movement of the beam 96 within the second sleeve 94, which in turn is driven by a pneumatic cylinder 98 linking the respective members. Vertical movement of the gripper assembly 50 is achieved by operation of the pneumatic cylinder 92.

The conveyer station 54 is mounted to the carriage assembly 52 by means of a beam arrangement 100. The conveyer station 54 comprises a pair

of generally co-planer belt assemblies 102(a) and (b). The belt assemblies 102 each comprise a housing 104, having journalled therein a pair of rotatable pullies 106 at either end thereof, supporting the opposing ends of a rotatably driven belt 108. A motor 110 drives both the first of the belts 108(a) and 108(b). The respective belts are geared together through meshing spur gears mounted on corresponding belt drive shafts. The first housing 104(a), with the motor 110 mounted thereto, is fixed to the beam arrangement 100. The second housing 104(b) is pivotally mounted to the beam arrangement 100 for pivoting about a vertical axis. When the respective housings 104(a) and (b) are swung together within the closed position, the respective belts 108(a) and (b) are parallel to and in substantial contact with each other. Within the open position shown in Figure 3, the belts 108 diverge. When in the diverged position, the belts are able to receive a filled bag, and subsequently swing together in to the closed position for conveyance of the bag away from the apparatus.

Operation of the devise will now be described by reference to Figures 107(a)-(i).

Operation of the apparatus commences with an individual bag 110, comprising the first bag in the interconnected array of bags 46, being supported by the wicket members 44 and positioned directly below the hopper 28. An air nozzle 112 mounted to the wicket support 43 directs a stream of air into the at least partly open mouth of the bag 110, to open the bag sufficiently for filling and to hold the bag open as the jaws 36 and 38 of the hopper 28 descend into the bag 110, as shown in Figure7(b). The hopper 28 then discharges a measured amount of the commodity into the bag 110. As the hopper is discharging the commodity, the bag gripper assembly 50 advances laterally towards the hopper 28, as seen in Figure 7(c)-(e), and subsequently downwardly, as seen in Figure 7(f), such that the downwardly-depending fingers 67 of the inner arms 66 extend into the open mouth of the bag 110. The jaws 36 and 38 of the hopper 28 then close and the hopper moves upwardly, as shown in Figure 7(g) and (h).

Simultaneously, the inner arms 67 of the gripper diverge, thereby drawing taut the mouth of the bag 110 and gripping opposing corners of the bag between the respective inner and outer fingers 64 and 67, as seen in Figure 7(h). The gripper assembly 50 then retracts laterally, as seen in Figure 7(i), and transfers the bag 110 longitudinally to the conveyer station 54. Retraction of the first bag 110 away from the interconnected array of bags 46 draws the subsequent bag 111 in the array forwardly in position beneath the hopper 28. The filled bag 110 is then conveyed longitudinally along the paired bars 82, towards the conveyor station 54. The paired belts 108 of the conveyer station 54 within the open position receive the bag 110, and subsequently converge to grippingly engage the bag between the respective belts 108, for conveyance towards a heat sealing station 120 or the like. Conventionally, the heat sealing station comprises a pair of heated belts 122 which may receive the bag directly from the conveyer to perform a heat sealing operation on the bag.

Operation of the device, and in particular, operation of the various pneumatic cylinders, is controlled by a central control unit, which in includes sensors for detecting the positions of the various components referred to above, and ensuring the various pneumatic actuators operate in a coordinated fashion.

It will be seen that although the present embodiment employs reciprocating pneumatic actuators for driving the various components of the apparatus, any known drive means may be substituted, including hydraulic rams, electric linear actuators or other like means.

It will be further understood, that although the present invention has been described in detail by way of a preferred embodiment thereof, persons skilled in the art to which this invention pertains will be able to make numerous modifications and variations to the invention. These variations and modifications

will still remain within the spirit and scope of the invention, which is described and characterized within the appended claims.